"HARDWARE IMPLEMENTATION OF DC DRIVE USING CHOPPER"

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Abstract- The speed of DC motor can be controlled from below rated speed using chopper as a converter. The chopper firing circuit receives signal from analog circuit and then chopper gives variable voltage to the armature of the motor for achieving desired speed.. The complete layout of DC drive mechanism is obtained. The designing of speed controller is carried out.

Keywords: **OP-amp 741 IC, Chopper, Resistive Load, DC-Motor**

1. Introduction

Development of high performance motor drives is very essential for industrial applications. A high performance motor drive system must have good dynamic speed command tracking and load regulating response. DC motors provide excellent control of speed for acceleration and deceleration. A chopper is a static power electronic device that converts fixed dc input voltage to a variable dc output voltage. A Chopper may be considered as dc equivalent of an ac transformer since they behave in an identical manner. As chopper involves one stage conversion, these are more efficient.

2. Methods of Speed Control

In many different applications it is required to control speed of DC motor. DC motors are also used in portable sewing machine, drill machine etc, in which speed control of motor is provided for different operation. One of the popular methods of speed control of DC motor is using chopper. *Chopper is a device that gives variable DC output from applied fixed DC input*. It simply chops fixed DC and generates variable DC. Let us first understand how it generates variable DC.

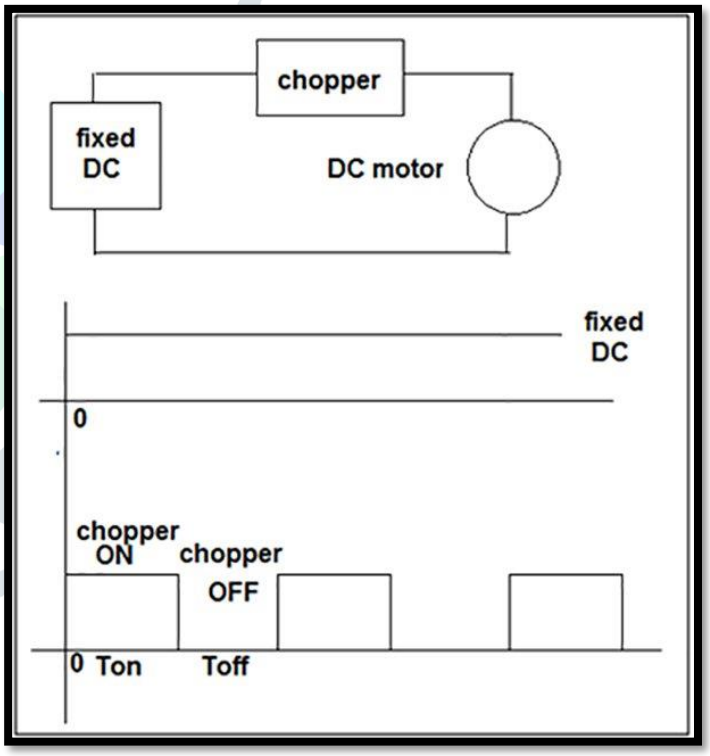

Fig. 01 Control Strategy of DC Drive

As shown in fig.01, the chopper supplies fixed DC voltage to motor. When chopper is ON motor gets supply but when chopper is off motor does not get the supply. So as shown in figure let us say chopper is on for Ton time and it is off for Toff time. So depending upon the Ton and Toff time the DC voltage applied to motor is:

$$Vdc = [T_{on} / (T_{on} + T_{off})] \times V_{fixed}$$

But, $T_{on} + T_{off} = T_{total}$

So, $Vdc = [T_{on} / T_{total}] \times V_{fixed}$

Here T_{on} / T_{total} is called duty cycle. So as duty cycle is more the average DC voltage supplied to motor is more and so speed of motor is increased. So as duty cycle is varied by varying on and off time of chopper, the speed of motor can be varied.

2.1 Control Circuit of DC Drive:

Pulse width Modulation is generated by using op-amp. Triangular wave is generated by integrating square wave generated by op-amp. Triangular wave is compared with variable DC voltage created by voltage divider circuit by op-amp. Then PWM signal is amplified by pulse amplifier. Pulse amplifier is designed by SL100 transistor. Whatever amplified PWM signal generated is given to gate of mosfet. By varying DC voltage, we can change width of pulse to gate of mosfet. And consequently it generates DC output voltage. Variable DC output voltage is given to DC motor. So we can control speed of DC motor. Control circuit and power circuit is shown in fig.02. Mosfet is used as switch of Chopper.

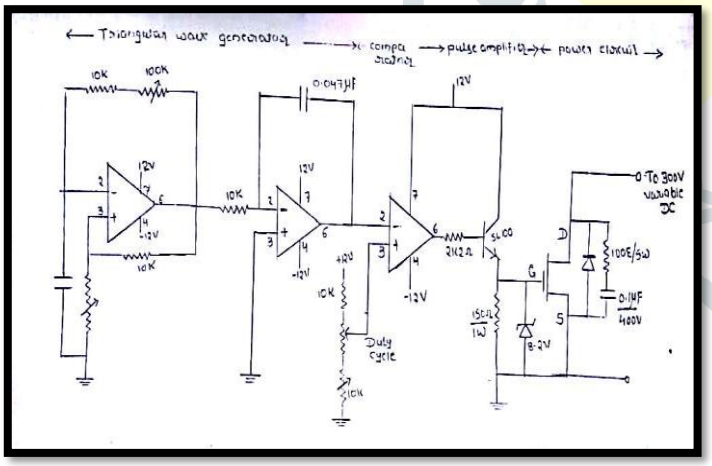

Fig.02: Circuit Diagram of DC Drive

3. Hardware Circuit of DC Drive:

DC Drive demonstration is shown in fig.03.

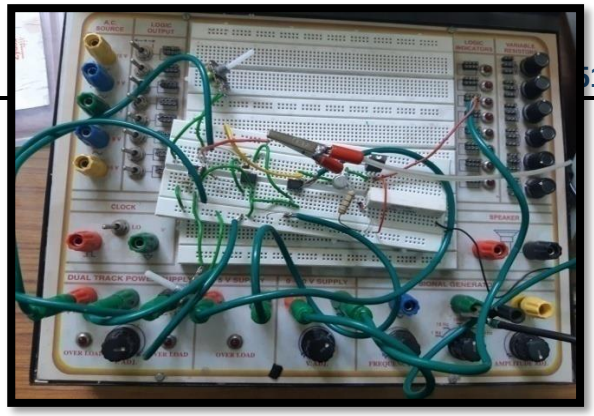

Fig.03 Hardware Circuit of DC Drive

In Fig.04, triangular wave output is shown in C.R.O.

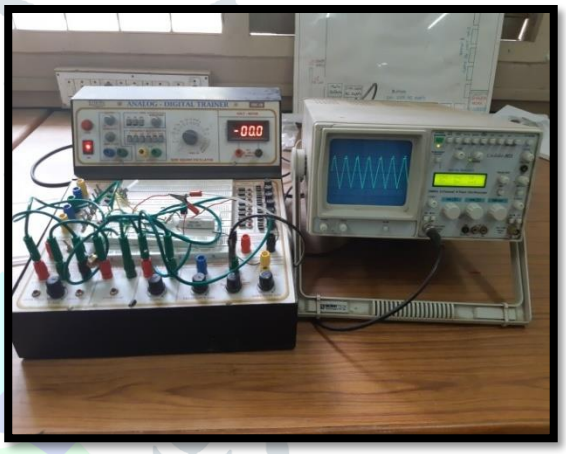

Fig.04 Waveform of Triangular Circuit

In fig.04, pulse width modulation waveforms are shown in C.R.O.

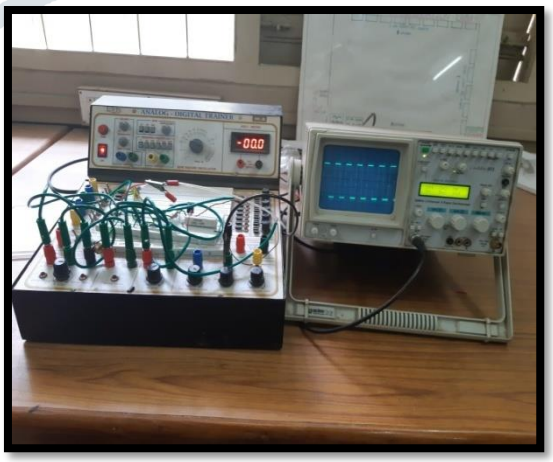

Fig.05 Waveform of PWM Circuit

R load having rating of 100Ω, 5 Watt is connected and output voltage is displayed in multimeter as shown in fig. 06

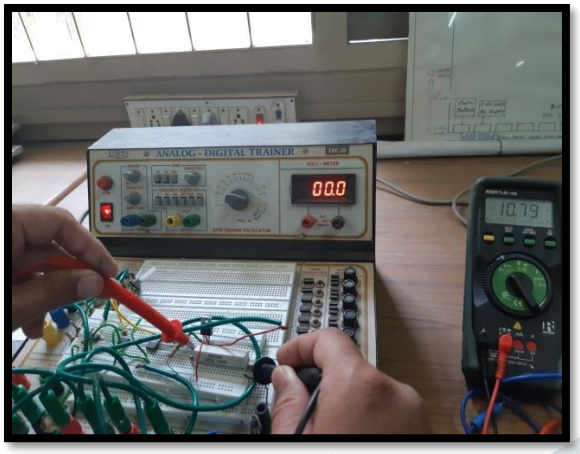

Fig.06 R Load connected to Drive

By using DC Drive, 12 volt DC Motor speed control is achieve as shown in fig.07.

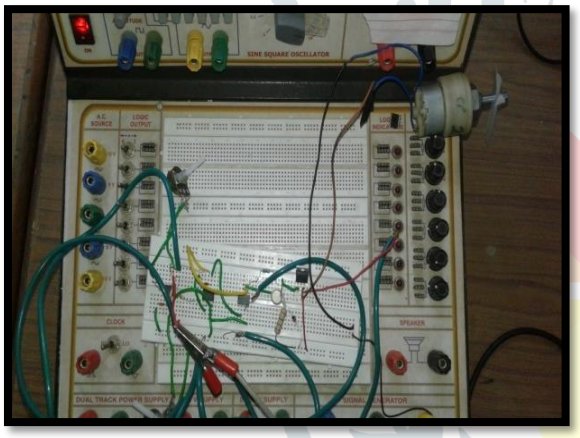

Fig.07 DC Motor connected to Drive

4. Advantages of Chopper Circuits:-

Chopper circuits have several advantages over phase controlled converters

1. Ripple content in the output is small. Peak/average and rms/average current ratios are small. This improves the commutation and decreases the harmonic heating of the motor.
2. The chopper is supplied from a constant dc voltage using batteries. The problem of power factor does not occur at all. The conventional phase control method suffers from a poor power factor as the angle is delayed.
3. Current drawn by the chopper is smaller than in phase controlled converters.

5. Conclusion:-

The speed of dc motor has been successfully controlled by using chopper as a converter. In hardware the speed of dc motor is achieved by varying on and off time of chopper using PWM technique. By this method we are able to control speed of DC motor below the rated speed.

6. Reference:-

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